Dairy Research

By Julio Giordano

Current research to improve dairy cattle performance and profitability through reproductive management strategies and adoption of new technologies.

Reproduction and technology field studies

The Dairy Cattle Biology and Management Laboratory in the Department of Animal Science at Cornell University is focused on conducting research that can be applied by commercial dairy farms to improve herd performance and profitability. Research spans the development of reproductive management protocols to on-farm evaluation of new technologies. Our laboratory is now conducting two large field studies on commercial NY dairy farms.

One ongoing study evaluates the impact of extending the voluntary waiting period (VWP) on reproductive performance and profitability. Determination of the optimal VWP is critical because this management decision has implications on the timing of pregnancy during lactation, and affects cow productivity and profitability. Duration of VWP impacts profitability because it affects timing of pregnancy for a significant number of cows.

Traditionally, dairy farms in the US initiated AI of cows at ~40 to 50 days (d) postpartum because cows needed extended time and services to conceive. In recent years well-managed dairy herds have made strides in all areas of management, leading to better cow health, which, coupled with efficient reproductive protocols that ensure timely insemination and high fertility, result in significant improvements in reproductive and productive performance.

Dairy farmers then observe a reduction in the time and variation required for cows to become pregnant. This is important because previous research suggests that pregnancy at ~100 to 120 DIM maximizes cow profitability. Extending the VWP by a reasonable amount of time (20 to 30 d) from the traditional 50 DIM may be a simple and inexpensive change with potential to impact reproductive performance, and through the timing of pregnancy, profitability.

Because limited data is available about the reproductive performance and profitability of dairy cows managed with an extended VWP, farmers determine its duration without a clear understanding of its implications. Therefore, the goal of our research is to investigate the impact of extending the VWP. We hypothesize that extending the VWP will help improve uterine health, metabolic status and reduce the rate of anovulation (non-cycling) in dairy herds and thereby, improve reproductive performance.

Whether profitability will improve is an open ended question that depends upon many factors such as the resulting change in the pattern of pregnancy during lactation, the effect of timing of pregnancy on milk production in the current and subsequent lactation, and replacement dynamics. Our long-term goal is to help farmers make informed decisions about the VWP for their own cows according to the productive and economic conditions of their farms.

The large research trial is being conducted on three NY commercial dairy farms. We aim to enroll at least 1,500 cows to have sufficient statistical power to detect differences in fertility for first AI service postpartum and for subsequent reproductive performance. All reproductive and economic parameters will be collected during the lactation in which treatments are received, as well as the first half of thier subsequent lactation, to evaluate profitability. Multiple blood samples and tests are also being conducted in hundreds of cows to provide a physiological explanation for any differences observed between the treatments. This research is supported by a grant from the New York Farm Viability Institute.

Another set of studies recently concluded by our laboratory evaluated the performance of a rumination and activity monitoring system to identify cows with health disorders in the early postpartum period. Methods for earlier and accurate identification of cows with health disorders may have major benefits to cow health, welfare and productivity, while reducing labor time for monitoring cow health.

Because depressed feed intake and changes in behavior are the preamble of metabolic and infectious diseases in dairy cows, monitoring rumination (as an indicator of feed intake) and cow activity (as an indicator of behavior) during the pre- and post-calving period could be an invaluable method to identify cows at early stages of disease.

Changing the course and/or reducing the sever-

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level of energy (about 125% of the estimated requirements) from 28 days before expected calving until the day of calving (intermediate energy group, n=28). Cows were entering second or greater parity.

Straw was chopped to a target length of two inches before mixing into the TMR. Diet composition is shown in Table 1. All cows received the same fresh cow TMR after calving (Table 1). Blood samples were taken three times per week in the close-up and fresh period. Non-esterified fatty acid (NEFA) and BHBA concentration were measured, as well as dry matter intake, milk production and composition.

Estimation of mean energy balance by CNCPS analysis for the whole dry period was 112, 126 and 153% of requirements and estimated supply of metabolizable protein was 124, 123 and 118% for those same groups.

Data from this study showed that cows fed a controlled energy diet throughout the whole dry period mobilized less adipose tissue as reflected by lower concentrations of NEFA in the first three weeks after calving (Table 2). They also had lower concentrations of BHBA postpartum while milk production and postpartum DMI intake were not affected. No cows were treated for clinical ketosis (BHBA ≥ 2.5 mmol/L) in the controlled energy group while four cows in the intermediate and five cows in the high group received treatment. There were twice as many events of subclinical ketosis (BHBA ≥ 1.2 mmol/L) in the intermediate and high energy groups compared to the controlled energy group in the first 21 days in milk.

Cows fed an intermediate energy level in a step-up system had the same milk yield and postpartum DMI as cows in the other two groups. When taking into account concentrations of NEFA and BHBA postpartum, as well as treatment for clinical ketosis and episodes of subclinical ketosis, cows fed an intermediate energy level in a step-up system prepartum showed some of the same effects of a more pronounced negative energy balance as cows fed a high energy diet for the whole duration of the dry period. Average immunoglobulin concentrations in colostrum were highest in the controlled energy group (96.2 g/L) and lowest in the high energy group (72.4 g/L, P=0.03).

Table 2. Least squares means for energy metabolites, DMI and milk yield.

Measurement		Dietary Treatment: Controlled	Intermediate	High	*SEM*	P
BHBA,	prepartum	0.29[a]	0.30[ab]	0.34[b]	0.01	0.04
mmol/L	postpartum	0.63[a]	0.77[ab]	0.85[b]	0.06	0.05
NEFA,	prepartum	237[a]	180[b]	175[b]	12	0.001
uEq/L	postpartum	659[a]	664[a]	796[b]	37	0.02
DMI, kg/d	prepartum	14.2[a]	15.3[b]	16.4[c]	0.3	0.001
	postpartum	22.3	22.4	22.4	0.6	0.99
Milk, kg/d		43.8	43.6	43.9	1.2	0.98
ECM, kg/d		46.1	47.0	48.3	1.2	0.48

[abc] *Row means with different superscripts differ (P<0.05)*

Although sample size in this study was not adequate to compare health events, epidemiological data linking high BHBA and NEFA concentrations to an increased risk for several periparturient disorders, including displacement of the abomasum, metritis, reduced reproductive success as well as decrease in milk production and removal from the herd has been described in several recent studies.

In this study, feeding a controlled energy diet throughout the whole dry period showed clear advantages to prevent excessive negative energy balance that could lead to downstream disease and improve colostrum quality without affecting milk yield.

ACKNOWLEDGEMENTS

This project is supported by the Agriculture and Food Research Initiative competitive grant no. 2012-67015-30230 from the USDA National Institute of Food and Agriculture. ❒

Reproduction and technology field studies

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mark behavioral.

Therefore, some of the objectives of our recently concluded research projects conducted at a commercial dairy farm include:

1-Comparing the timing required to identify cows with health disorders (metritis, subclinical and clinical ketosis, displaced abomasum, mastitis, milk fever, and lameness) using a combination of rumination and activity data and daily observations by personnel versus personnel alone;

2-Correlating rumination activity during the pre- and early post-fresh period with markers of metabolic status (NEFA's, BHBA's, Calcium) and systemic inflammation (Haptoglobin);

3-Characterizing early changes in feed intake based on rumination and behavior based on activity in cows undergoing health disorders; and

4- Correlating the daily variation in rumination with daily variation in milk yield during the first 90 DIM.

On-farm research studies are a necessary first step to determine the ability of novel technologies such as rumination and activity monitoring to enable earlier identification of cows with health disorders. Correlating rumination and activity with the occurrence of disease and different markers of metabolic status and inflammation, will allow identification of health monitoring and treatment strategies that maximize cow productivity and reproductive performance, and demonstrate the value of these technologies to dairy producers. We are currently working on evaluating the data generated in these studies so, stay tuned to hear about our findings! ❒